

Ceramic Supported Pt-Ru Catalysts for H₂/CO Oxidation

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Introduction

Pt-Ru dispersed onto high surface area metal carbide support materials (Thompson, 1997; Pu, 1998; Tarnowski, 1998) was explored as an anode catalyst for PEM fuel cells. The onset for CO oxidation was strongly influenced by the composition and electrochemical history of the catalyst. Carbide supported Pt-Ru electrocatalysts exhibited lower onset potentials for CO oxidation than carbon supported Pt-Ru.

Experimental

High surface area transition metal carbide support materials were produced by thermally reacting oxide precursors with gas-phase reactants. The resulting carbide phase was characterized by x-ray diffraction. Support material surface areas were determined by gas adsorption methods.

Pt and Pt-Ru alloy particles were dispersed onto carbide support materials through the chemical reduction of Pt-Ru oxide species (Watanabe, 1986). Noble metal composition and crystallite sizes for supported catalysts were determined by atomic absorption spectroscopy and x-ray diffraction.

Catalyst inks (Wilson, 1992) were prepared and deposited onto carbon current collectors. CO stripping experiments were carried out in three-electrode cells at 25°C and 60°C in oxygen free 1 N H₂SO₄ electrolyte.

Results and Discussion

High surface area (50-80 m²/g) carbide support materials were produced by carefully controlling thermal and reactive atmosphere conditions.

X-ray diffraction analysis of ceramic supported catalysts suggests noble metal sites are either too small to produce diffraction patterns or are amorphous. The electrochemical surface area of noble metals was estimated to be 50-80 m² Pt/g Pt by CO stripping methods.

Cyclic voltammetry indicates the presence of highly dispersed noble metal sites on the surface of the carbide support materials. Interaction

between the noble metals and support material appears to reduce the onset potential for CO oxidation versus Pt-Ru on carbon supports (see Fig.1). Pre-cycling of carbide supported catalysts appears to further reduce the onset potential for CO oxidation. The effects of catalyst composition and pre-cycling on PEM fuel cell performance will also be presented.

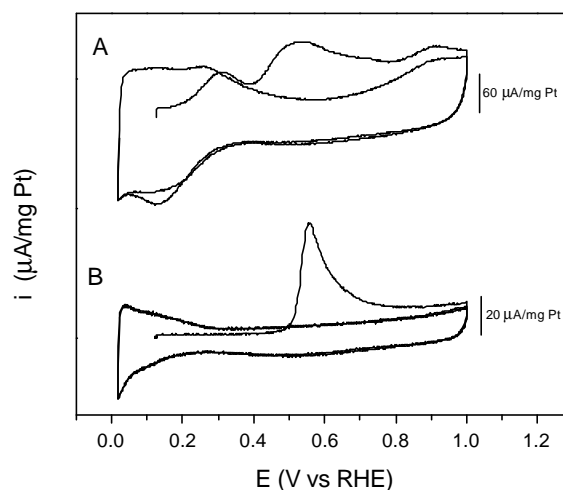


Fig 1. CO stripping voltammograms recorded at 20 mV/s in 1 N H₂SO₄. CO bubbled into cell for 30 minutes followed by a 30 minute purge with N₂. Electrodes held at 0.125 V vs. RHE prior to scans. Experiments performed at 25°C.
(A) 6% Pt, 3% Ru on carbide support, 0.5 mg noble metals/cm².
(B) 19% Pt, 9% Ru on Vulcan XC-72 R support, 0.06 mg noble metals/cm².

References

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